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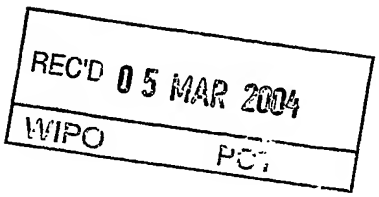

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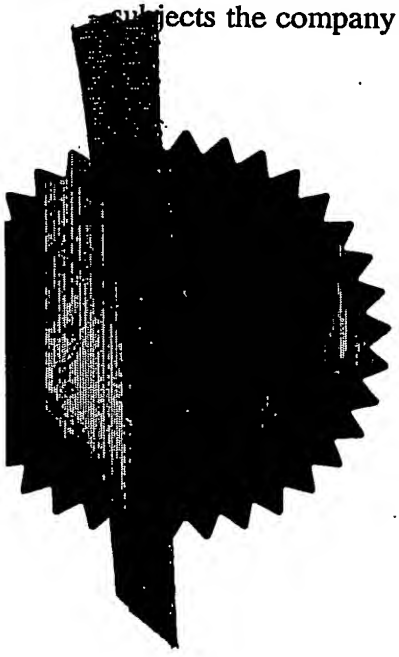

Signed R. Mahoney

Dated 20 February 2004

Patents Form 1/77

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1/77

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

03 FEB 2003

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

GW/MK/G33125

03FEB03 E781983-2 000346
P01/7700 0.00-0302405.6

2. Patent application number
(The Patent Office will fill in this part)

0302405.6

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

(1) John GORDON and (2) Corey GORDON
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Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

(1) 8532897001
(2) 8533325001

4. Title of the invention

Suit for use in water

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Bailey Walsh & Co
5 York Place
Leeds
LS1 2SD

224001

Patents ADP number *(if you know it)*

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

No

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	8 ✓
Claim(s)	
Abstract	
Drawing(s)	2 only ✓

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature: Bailey Walsh + Co

Date: 3rd February 2003

12. Name and daytime telephone number of person to contact in the United Kingdom: G WOOD 0113 243 3824

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Suit for use in water

The invention to which this application relates is a suit for use in water, said suit typically worn by a person in conjunction with other diving apparatus. For ease of reference, but in a non-limiting manner, the suit will hereafter be referred to as a wetsuit in this application.

A wet suit is typically worn by persons participating in underwater diving either for leisure or industry and the basic structure of the same is provided to allow a controlled flow of water within the suit to improve the insulation of the same and hence improve the warmth of the wearer. The basic construction typically comprises an inner layer and an outer layer with passages between the same through which the controlled amount of water can pass. The water is not permitted to move to the extremities of the wetsuit as, if this occurred, a large percentage of the retained diver heat energy would be lost. This control is typically achieved by the provision of relatively snug fitting cuffs in the wrist and ankles and a snug collar or attached hood around the neck or head. Zippers can also be provided and, in conjunction with sealing flaps, can be adjusted to limit the passage of water through the zipper and hence the wetsuit.

The wetsuits are conventionally manufactured using closed cell foam rubber such as, for example, using neoprene or chloroprene. The foam rubber material includes closed cells which act to trap air or gas therein and afford thermal protection and benefit to the wearer. However, during diving, the water pressure increases on the wetsuit and hence the rubber foam and acts to crush the closed cells in the material, reducing the volume of trapped air and depleting the thermal protection offered by the wetsuit as the wearer descends. When one considers that the water itself is likely to get colder as the wearer goes deeper, it will be appreciated that the wearer can

experience discomfort due to the temperature drop and this can act as a limitation on the activities of the wearer. Typically, every 10 metres of added depth adds another atmosphere of pressure exerted on the wetsuit and, as the majority of diving activity occurs at depths of 25-50 metres so the pressure exerted can be large and in the order of 11000 to 23000 lbs per square foot in that depth range. The effect of this on the rubber foam material used for the wetsuit is to, for example, crush a 7mm thick neoprene suit to under 2mm at the 30 metre depth range, thereby significantly crushing the closed cells in the foam rubber and hence significantly reducing the thermal protection provided.

In addition to thermal loss due to the increase in pressure, another result of the crushing of the closed cells in the wetsuit material is that there is a corresponding loss of buoyancy for the wearer as they descend. This buoyancy loss can be significant and, as a result, the diver is often required to wear a buoyancy compensator which is typically worn about the upper torso in a similar manner to a life jacket. As required, air is forced into the compensator from the diver's air tank under the control of the diver. While the buoyancy compensator is effective it does represent another piece of apparatus required to be carried by the diver and can, in certain instances limit the degree of access which the diver has to certain confined areas. As such the buoyancy compensator is regarded as being necessary but inconvenient.

The aim of the present invention is to provide an improved wetsuit configuration which allows the thermal advantage provided to the wearer to be improved, particularly when pressures of the extent discussed are exerted on the wetsuit. A further aim is to provide a wetsuit which does not experience as significant a reduction in buoyancy as conventional wetsuits when pressure is exerted on the same.

In a first aspect of the invention there is provided a wetsuit during diving, said wetsuit including a layer of material, and at at least a portion or portions of said suit water can pass between the inner surface of the said layer of material and the diver and wherein at at least said portion or portions a quantity of wool, or wool with other fibres or materials added thereto, is provided to lie between the diver and said layer of material and in contact with said water.

In one embodiment, solely wool is provided but in alternative embodiments the wool can be provided mixed with other fibres or materials to add or provide specific features to the wool. For ease of reference hereonin, reference is made to wool alone, but it should be appreciated that the embodiments are equally applicable to all possible wool combinations and fall within the scope of this patent application.

In one embodiment, the wool is provided wherever water is permitted to pass between the diver and layer of material. Typically water is permitted to pass at the same locations as in a conventional wetsuit.

In one embodiment the layer of material of the wetsuit is manufactured from conventional material such as neoprene or chloroprene. In one embodiment the wool is separate to the layer of material and worn as a separate layer., although the same may be attached to the said layer at one or several locations. However, more preferably the wool is provided attached, typically by lamination, to the inner surface of the layer of material so as to lie adjacent the diver's skin when the wetsuit is worn.

Typically the wool is provided in a laminated arrangement with the layer of material so as to provide an even thickness lining on the

interior of the wetsuit. The wool acts to absorb and contain the water which is permitted to pass within the suit and between the layer of material and the wearer.

In a preferred embodiment the wool used is Merino wool.

In one embodiment the wetsuit includes an outer layer, said outer layer formed of a suitable material to provide required protection from the external environment in which the wetsuit is to be worn.

In a further aspect of the invention there is provided a method of manufacturing a wetsuit for diving, said method comprising forming a layer of rubber foam into a shape for wearing by a diver, providing means in the said rubber foam to permit the flow of water between the inner surface of said layer and the divers skin when the wet suit is worn, providing control means to allow the control of the quantity of water and wherein a layer of wool or wool containing material is provided in conjunction with the wetsuit to lie between the diver and the layer of rubber foam when worn.

Typically the method includes the step of laminating the wool material as a lining to the inner surface of the layer of material and in a manner to ensure that the water passing into the area between the diver and the layer of material contacts and is absorbed by the wool material.

In one embodiment the wool is knitted into a layer and laminated to the foam rubber.

Specific embodiments of the invention are now described with reference to the accompanying drawings wherein,

Figure 1 illustrates a cross section of part of a wetsuit in accordance with the invention, being worn; and

Figure 2 illustrates a cross section through part of the wetsuit in accordance with the invention in more detail.

Referring now to Figure 1 there is illustrated a wearer 2 wearing a wetsuit 4 with the wall of the same cut through in section for the purpose of illustration.

In accordance with the invention the wetsuit comprises, in this embodiment, a layer of neoprene or chloroprene 6 and on the inner surface of the same is a layer of Merino wool 8 laminated to the layer 6. The wool lining acts to absorb the water which passes between the inside of the layer 6 and the skin 10 of the wearer 2. The water is absorbed and held by the wool fibres to form a thermal barrier between the divers skin and the rubber foam closed cells.

The wetsuit also includes control zones in the form of smoothskin seals at the collar 12 and cuffs 14 which serve to restrict and prevent the flow of water in and out of the wetsuit at the extremities of the suit. The head portion 16 of the wetsuit is permanently attached or can be sealed with the same by the collar 12 and may also include the wool lining 8. The control zones prevent the flushing of water in and out of the wetsuit and hence minimise heat loss and ensure that the water enters the interior of the wet suit in a controlled manner through "zippers" (not shown) at selected locations on the wetsuit.

Figure 2 illustrates a typical portion of the material wall of the wetsuit in accordance with the invention in cross section.

The wall includes the layer of neoprene 6 with an "inner" surface 20 which, when worn, faces the divers skin 10. To this surface is laminated a wool layer, preferably knitted Merino wool, 8 which in turn contacts the divers skin 10. An outer protective layer 22 can also be provided as an option and can be laminated to the outer surface of the layer 6 as shown to improve the strength of the wetsuit.

Thus, in use, when worn, the wool layer faces and contacts the skin of the diver. The wool layer is typically knitted and laminated using standard gluing/ laminating techniques, to the inner face of the rubber foam. The weight of the wool lining can be, but is not limited to, 150 to 300 grammes per square metre. The water, when it enters the area between the neoprene inner surface and the skin in which the wool lies is thus absorbed by the wool and this has several advantageous effects.

In the first instance the water and wool forms a layer, of for example 3-5mm, of substantially non-compressible water and wool. This layer and in particular the water held in the layer acts as a very efficient thermal barrier which, because it is substantially non compressible is not significantly acted upon the increased pressure as the depth of the diver in the water increases and therefore maintains its thermal efficiency at increasing depths. The water is absorbed by the wool layer and retained by the wool fibres to form the thermal barrier between the diver skin and the neoprene foam with the closed cells therein.

Confidential thermal testing at BTTG laboratories in Manchester UK has taken place using saturated 260g/sq metre Merino wool lining in comparison with the densest most absorbent polyester loop pile lining of a similar or slightly heavier weight. The comparison has revealed that with thermal testing in saturated conditions on

7mm neoprene the Merino wool/neoprene laminate was 35% more efficient with a TOG reading of 1.7 as opposed to the polyester loop pile/neoprene laminate that had a TOG rating of 1.26.

Furthermore the Merino wool lining will absorb typically a 0.5mm to 3.0 mm layer of water into the fibre of the wool such that as a diver descends, the neoprene foam closed cells are crushed as conventionally occurs but, as the layer of water in the wool is substantially non compressible, it is not crushed and hence the thickness of the layer and hence thermal efficiency and benefits are maintained for the diver.

Another important advantage is that as the water has a relatively high thermal inertia, it is able to absorb a large amount of heat energy and thus effectively a heat sink is created around the diver which absorbs the heat emitted by the diver during periods of work, retains the same and emits the same back to the diver during periods of lower exercise.

A further result of the use of a wool layer in accordance with the invention is that the level of buoyancy loss as the diver descends is reduced in comparison to the conventional wetsuits. This, in turn means that a smaller Buoyancy compensator can be used and an easier, more comfortable, and safer diving profile to be maintained by the diver. This can be particularly used to advantage if the layer of rubber foam is reduced in thickness and the layer of wool increased in thickness thereby retaining and improving the thermal efficiency of the wetsuit while at the same time improving the buoyancy of the wetsuit as the compressible element of the wetsuit is reduced.

The use of Merino breed wool is preferred as this gives greater advantage. Specifically, the Merino wool provides an exothermic

reaction during the wetting process which can be referred to as the heat of sorption. Merino wool also has high wrinkle and crush recovery thus further enhancing the thermal properties. It is also known that the Merino wool is resistant to odour , hydrophilic, highly elastic with excellent recovery characteristics and relatively non itchy and comfortable in wet or dry condition which is obviously advantageous when the layer is to be positioned close to the skin. It is therefore preferred that the wool layer is formed of or contains elements of Merino wool therein, although it will be appreciated that this should not limit the scope of the patent application to this form of wool alone.

The wetsuit structure in accordance with the invention therefore provides a solution to the thermal and buoyancy problems conventionally experienced.

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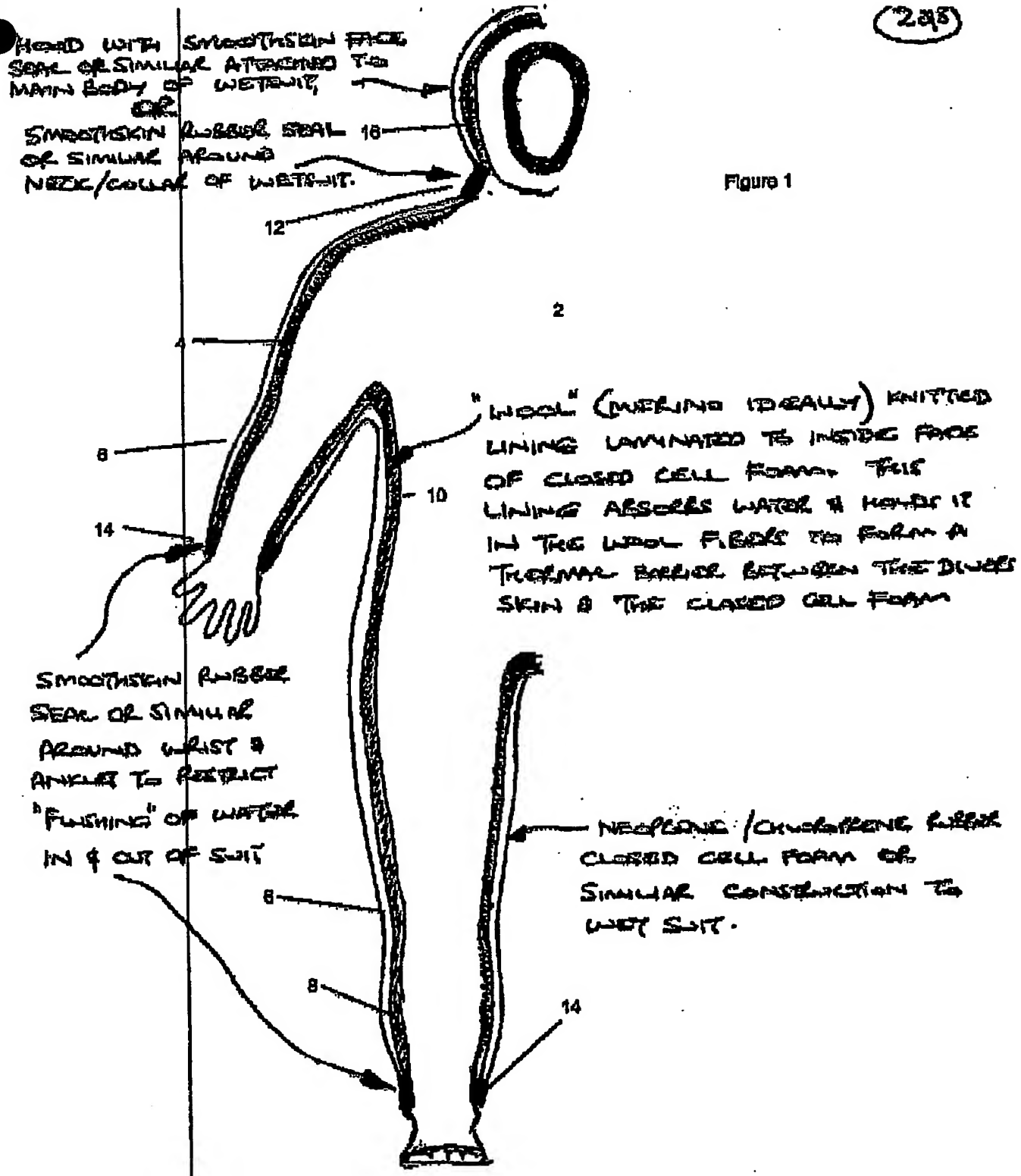

Figure 1

CROSS SECTION THROUGH SUIT

John Gordon
31.1.03

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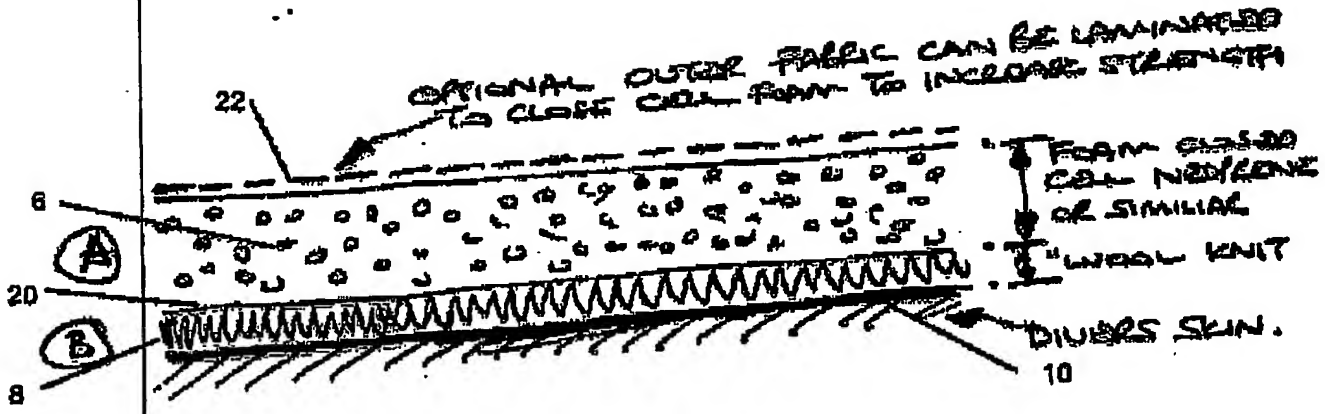
Figure 2



(A) CLOSED CELL FOAM COMPRESSES WITH DEPTH & THUS THERMAL EFFICIENCY DECREASES WITH DEPTH.

(B) "WOOL" KNIT LAMINATED TO INSIDE FACE OF CLOSED CELL FOAM ABSORBS WATER TO FORM A TRAPPED 0.5 to 3mm THICK LAYER OF NON-COMPRESSABLE WATER. THIS WATER ACTS AS A VERY EFFICIENT THERMAL BARRIER WHICH BECAUSE IT IS NON-COMPRESSABLE MAINTAINS ITS THERMAL EFFICIENCY AT DEPTH.

CROSS SECTION THROUGH MATERIAL

John Graham
31.1.03

PCT Application
PCT/GB2004/000418